ESE- 911 Carbon Capture and Utilization

Credit Hours: 3 **Pre-requisites: Nil**

Course Objectives:

- Explain different carbon capture approaches and carbon separation
- technologies
- Demonstrate an in-depth understanding of post-combustion carbon
- capture with chemical absorption
- Evaluate critically the advantages and limitations of various carbon
- capture approaches and separation technologies
- Demonstrate the ability to select different carbon separation
- technologies for different scenarios.
- To describe the sequestration techniques especially geological
- sequestration
- Explain different technologies for the utilization of CO_2

Course Contents: Carbon, Energy and Atmosphere: (1) Primary carbon sources, scales and the challenge (2) Large emission sources of CO_2 (3) The carbon cycle (4) Coal-fired power plants (5) Oil and gas operations (6) Industrial activities such as chemical, fertilizer and cement manufacturing **Overview of carbon capture and utilization:** (1) Carbon dioxide capture and storage (CCS) Technology (2) Carbon dioxide capture and Utilization (CCU) Technology (3) Economic Aspects of CCS and CCU **CO2 Capture:** (1) Separating CO2 from regular flue gas (2) Modifying the fossil fuel combustion technology **Post-Combustion Carbon Capture Technology:** (1) Process of post combustion Carbon Capture Technology (2) Solvents and Sorbents (3) Advanced Membranes Technology (4) Chemical Looping **Pre-Combustion Carbon Capture Technology:** (1) Process of pre combustion carbon capture technology (2) Reforming and gasification (3) Integrated Gasification Combined Cycle (IGCC) as commercial application (4) Clean hydrogen production **Oxyfuel combustion Carbon Capture Technology:** (1) Process of oxyfuel combustion carbon capture technology (2) Oxyfuel-combustion plant with near zero emissions **CO_2 Utilization:** (1) Enhanced oil/ Gas recovery application (2) CO_2 as Feedstock to produce fine chemicals (fuels and polymers (3) Breakthrough Concepts (4) Direct Utilization of Carbon Dioxide via Microalgae (5) Carbon Dioxide to Energy Products (6) CO_2 neutral or green fuels (7) Applications for the desalinated water **Carbon storage/ sequestration:** (1) Overview of carbon storage (2) Geologic Storage Technology (3) Oil and gas reservoirs (4) Coal bed methane (5) Saline Formations (6) Risk assessment for carbon storage

Course Outcomes:

- To describe CO_2 Capture technologies, Utilization and Sequestration.
- The students will be able to understand the role of carbon sequestration in
- the climate change mitigation portfolio.
- Students will learn fundamentals CO_2 migration in geologic formations.
- Students will be able to comprehend the current status of utilization
- technologies

Recommended Reading (including Textbooks and Reference books)

- Smit, Berend, et al. Introduction to carbon capture and sequestration. Vol. 1. World Scientific, 2014.
- Goel, Malti. Carbon capture, storage and, Utilization: A possible climate change solution for energy industry. The Energy and Resources Institute (TERI), 2014..
- Styring, Peter, Elsje Alessandra Quadrelli, and Katy Armstrong, eds. Carbon dioxide utilisation: closing the carbon cycle. Elsevier, 2014.